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(54) Method and apparatus for encoding a video signal using region-based motion vectors

(57) A motion compensation block for use in a motion-compensated video signal encoder determines a predicted current frame based on a current frame and a previous frame of a digital video signal.

The motion compensation block comprises a segmentation block for segmenting the previous frame into one or more segmented regions; a region-based displacement estimator for providing one or more displacement vectors between the current and the previous frames, each of the one or more displacement vectors representing a motion of each of the one or more segmented regions; a prediction block for constructing an intermediate predicted frame by translating each of the one or more segmented regions by a corresponding displacement vector; and a post-processing block for producing a motion vector for each pixel included in the intermediate predicted frame based on said one or more displacement vectors and generating a pixel value of the previous frame which corresponds to the motion vector for each pixel of the intermediate predicted frame as a pixel value thereof to thereby determine the predicted current frame.

FIG.3A

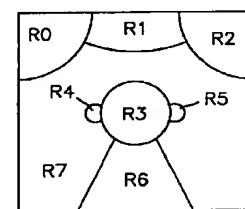


FIG.3B

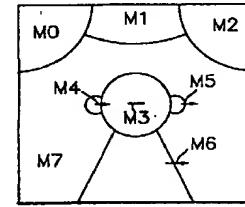
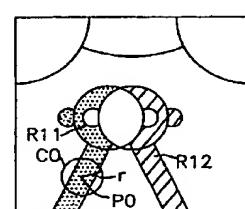


FIG.3C



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Description**Field of the Invention**

The present invention relates to a method and an apparatus for encoding a video signal; and, more particularly, to a method and an apparatus for encoding a video signal using region-based motion vectors.

Description of the Prior Art

As is well known, transmission of digitized video signals can attain video images of a much higher quality than the transmission of analog signals. When an image signal comprising a sequence of image "frames" is expressed in a digital form, a substantial amount of data is generated for transmission, especially in the case of a high definition television system. Since, however, the available frequency bandwidth of a conventional transmission channel is limited, in order to transmit the substantial amounts of digital data therethrough, it is inevitable to compress or reduce the volume of the transmission data. Among various video compression techniques, the so-called hybrid coding technique, which combines temporal and spatial compression techniques together with a statistical coding technique, is known to be most effective.

Most hybrid coding techniques employ a motion compensated DPCM(differential pulse coded modulation), two-dimensional DCT(discrete cosine transform), quantization of DCT coefficients, and VLC(variable length coding). The motion compensated DPCM is a process of determining the movement of an object between a current frame and its previous frame, and predicting the current frame according to the motion flow of the object to produce a differential signal representing the difference between the current frame and its prediction. This method is described, for example, in Staffan Ericsson, "Fixed and Adaptive Predictors for Hybrid Predictive/Transform Coding", IEEE Transactions on Communications, COM-33, No. 12(December 1985); and in Ninomiya and Ohtsuka, "A Motion-compensated Interframe Coding Scheme for Television Pictures", IEEE Transactions on Communications, COM-30, No. 1 (January 1982).

The two-dimensional DCT, which reduces or removes spatial redundancies between image data, converts a block of digital image data, for example, a block of 8x8 pixels, into a set of transform coefficient data. This technique is described in Chen and Pratt, "Scene Adaptive Coder", IEEE Transactions on Communications, COM-32, No. 3(March 1984). By processing such transform coefficient data with a quantizer, zigzag scanning, and VLC, the amount of data to be transmitted can be effectively compressed.

Specifically, in the motion compensated DPCM, current frame data is predicted from the corresponding previous frame data based on an estimation of the motion between the current and the previous frames. Such esti-

mated motion may be described in terms of two dimensional motion vectors representing the displacement of pixels between the previous and the current frames.

Several methods for estimating the displacement of an object in a video sequence have been proposed. Generally, they can be classified into two types: a pixel recursive algorithm; and a block matching algorithm(see e.g., J.R. Jain et al., "Displacement Measurement and Its Application in Interframe Image Coding", IEEE Transactions of Communications COM-29, No. 12(December 1981)).

According to the block matching algorithm, which is more widely used, a current frame is divided into a multiplicity of search blocks. The size of a search block typically ranges between 8x8 and 32x32 pixels. To determine a motion vector for a search block in the current frame, a similarity calculation is performed between the search block of the current frame and each of a plurality of equal-sized candidate blocks included in a generally larger search region within a previous frame. An error function such as the mean absolute error or mean square error is used to carry out the similarity measurement between the search block of the current frame and each of the candidate blocks in the search region. And a motion vector, by definition, represents the displacement between the search block and a candidate block which yields a minimum error function.

In a real image, a unit of a movement is an object or a region on an object rather than a block of a fixed size. Therefore, in a motion compensation using the conventional block matching algorithm, a blocking effect at the boundary of a block may occur, to thereby deteriorate the picture quality.

On the other hand, if an image is encoded using a region-based method and transmitted to a decoder, information about the region boundary will be needed in the decoding process at the decoder.

Summary of the Invention

It is, therefore, a primary object of the present invention to provide a method and apparatus for encoding and decoding a video signal employing a region-based method without requiring additional information about the region boundary, thereby improving the overall compression efficiency.

In accordance with the present invention, there is provided an apparatus, for use in a motion-compensated video signal encoder, for determining a predicted current frame based on a current frame and a previous frame of a digital video signal, comprising:

means for dividing the previous frame into one or more segmented regions;

means for providing one or more displacement vectors between the current and the previous frames, each of said one or more displacement vectors representing a motion of each of said one or more segmented regions;

means for constructing an intermediate predicted

frame by translating each of said one or more segmented regions by a corresponding displacement vector; and

means for producing a motion vector for each pixel included in the intermediate predicted frame based on said one or more displacement vectors and generating a pixel value of the previous frame which corresponds to the motion vector for each pixel of the intermediate predicted frame as the pixel value thereof, to thereby determine the predicted current frame.

Brief Description of the Drawings

The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram of a video encoder employing a motion compensation block of the present invention;

Fig. 2 shows a detailed block diagram of the motion compensation block shown in Fig. 1; and

Figs. 3A to 3C represent a diagram for explaining the procedure carried out in the motion compensation block.

Detailed Description of the Preferred Embodiments

With reference to Fig. 1, there is shown a block diagram of a video encoder which employs a motion compensation block 150 of the present invention. An input digital video signal is fed to a subtractor 102 and the motion compensation block 150.

At the motion compensation block 150, the current frame signal on a line L130 and a reconstructed previous frame signal on a line L132 from a frame memory 124 are processed to estimate displacement vectors, each of which represents a displacement between a region of the previous frame and a best matching region included in the current frame, wherein the region is defined as a group of pixels having similar characteristics. Each of the displacement vectors on the line L134 provided by the motion compensation block 150 is applied to a entropy coder 107.

At the motion compensation block 150, a prediction signal for the current frame is also determined by using the displacement vectors and provided to the subtractor 102 and an adder 115 on a line L160. Specifically, the prediction signal is predicted from the previous frame by using the displacement vectors as described with reference to Fig. 2.

The prediction signal from the motion compensation block 150 is subtracted from the current frame signal at the subtractor 102; and the resultant data, i.e., an error signal denoting the differential pixel value, is dispatched to an image signal encoder 105, wherein a block of error signals is encoded into a set of quantized transform coefficients, e.g., by using a discrete cosine transform(DCT) and any one of known quantization methods. Thereafter,

the quantized transform coefficients are transmitted via two signal paths: one toward an entropy coder 107, wherein the quantized transform coefficients are coded together with the displacement vector on the line L134 by using, for example, a combination of run-length and variable length coding, to thereby be provided to a transmitter (not shown) for the transmission thereof; and the other to an image signal decoder 113, wherein the quantized transform coefficients are converted back into a reconstructed differential error signal by using an inverse quantization and inverse transform, respectively. Reconstruction of the error signal is required in order for the encoder to track the behavior of the decoder in a receiver to thereby prevent the decoder's reconstructed signal from diverging from the current frame signal.

The reconstructed error signal from the image signal decoder 113 and the prediction signal from the motion compensation block 150 are combined at the adder 115 to provide a reconstructed current frame signal to be written onto the frame memory 124.

Referring to Fig. 2, there is shown a block diagram of the motion compensation block 150 of the present invention. In the present invention, region-based displacement vectors are used in the encoding and decoding processes. In other words, displacement vectors are determined on the basis of regions of an image. To reconstruct the image encoded by using the region-based displacement vectors, information about the regions is needed in a corresponding decoder. Since the amount of data which can be transmitted from the encoder to the decoder is limited, it is more efficient to recover the region information in the decoder than to transmit the information from the encoder.

A previous frame stored in the frame memory 124 in Fig. 1 is identical to the frame reconstructed in the corresponding decoder; and regions obtained by segmenting the reconstructed previous frame in the encoder are the same as those of the corresponding decoder. Therefore, if a current frame is encoded using displacement vectors each of which corresponds to each of the regions, it is possible to reconstruct the current frame in the decoder without transmitting information about the region from the encoder. Fig. 3A illustrates a reconstructed previous frame comprising a plurality of regions, e.g., R0 to R7.

The previous frame stored in the frame memory 124 shown in Fig. 1 is inputted to a segmentation block 20. At the segmentation block 20, the previous frame is segmented into a number of regions, e.g., R0 to R7 shown in Fig. 3A. Various methods may be used in the segmentation process (see, e.g., A. K. Jain, "Fundamentals of Digital Image Processing", 1989, Prentice-Hall International).

The region information is inputted to a region-based displacement estimator 30, wherein the position of each of the region and the pixel values included therein are contained in the region information. The current frame signal represented as the input digital video signal is also provided to the region-based displacement estimator 30.

At the region-based displacement estimator 30, the displacement vectors between the current frame and the regions of the previous frame are estimated. Fig. 3B shows displacement vectors M0 to M7 between the previous frame and the current frame, wherein each of the displacement vectors represents a motion of the corresponding region of the previous frame shown in Fig. 3A. For the sake of simplicity, it is assumed that zero valued displacement vectors are assigned to the regions R0, R1, R2 and R7, which represent a background; and displacement vectors M3 to M6 have an identical value.

The displacement vectors are provided to a prediction block 40 and to the entropy coder 107 shown in Fig. 1 on the line L134. The region information determined at the segmentation block 20 is also coupled to the prediction block 40. At the prediction block 40, an intermediate predicted frame is determined by shifting each region shown in Fig. 3A by the corresponding displacement vector shown in Fig. 3B. In Fig. 3C, the intermediate predicted frame is depicted. In Fig. 3C, an empty region, i.e., a dotted region R11, represents pixels to which no pixel in the previous frame corresponds; and an overlapped region, i.e., a shaded region R12, represents pixels to each of which more than one pixel in the previous frame correspond. The rest of the intermediate predicted frame, excluding the empty and the overlapped regions R11 and R12, represents pixels to each of which one pixel in the previous frame corresponds. The intermediate predicted frame often includes the empty and overlapped regions because the intermediate predicted frame is determined by shifting each region in the previous frame by the displacement vectors determined for each region of the previous frame.

The intermediate predicted frame from the prediction block 40 and displacement vectors from the region-based displacement estimator 30 are inputted to a post-processing block 50. At the post-processing block 50, a motion vector for each of the pixels included in the empty and overlapped regions are determined as will be explained hereinafter, wherein a motion vector represents a displacement between a pixel of the intermediate predicted frame and a pixel of the previous frame determined in accordance with the present invention.

To find a predicted current frame from the intermediate predicted frame shown in Fig. 3C, the displacement vectors from the segmentation block 20 are assigned first as motion vectors for corresponding pixels not included in either the empty region R11 or the overlapped region R12; and motion vectors for each of the pixel included in the empty region R11 and the overlapped region R12 are then determined. To find a motion vector for a pixel P0 of the empty region R11 shown in Fig. 3C, all neighboring regions whose parts overlap a circle C0 are first determined. The circle C0 is of a predetermined radius r with the pixel P0 at its center. In this case, regions R6 and R7 are such neighboring regions. The motion vector of the pixel P0 is determined as an average of the motion vectors for the neighboring regions. Motion vectors for other pixels included in the regions R11 and R12 are deter-

mined in a similar manner. Thereafter, a pixel value of the previous frame which corresponds to a motion vector for each pixel of the intermediate predicted frame is determined as a pixel value for each pixel of the predicted current frame.

Referring back to Fig. 2, by retrieving pixel values of the previous frame from the frame memory 124 via the line L132 based on the motion vectors determined at the post-processing block 50 as explained above, the predicted current frame is obtained.

In a decoder corresponding to the encoder of the present invention, the motion compensation block is of a similar structure to that of Fig. 2 except that there is not a motion estimator such as the region-based displacement estimator 30 shown in Fig. 2 because the displacement vectors transmitted from the encoder are provided thereto. The motion compensation block includes a segmentation block, a prediction block and a post-processing block whose functions are the same as those explained with respect to the encoder above.

Specifically, a previous frame signal from a frame memory of the decoder may be the same as that of the encoder as explained above. The previous frame is inputted to the segmentation block to be divided into a plurality of regions. The prediction block determines an intermediate predicted frame in response to the region information from the segmentation block and the displacement vectors transmitted from the encoder explained with reference to Fig. 2. The post-processing block provides a predicted current frame which is the same as that of the encoder. The predicted current frame signal is further processed in the decoder to recover the current frame which is similar to the original video signal.

While the present invention has been described with respect to the particular embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. An apparatus, for use in a motion-compensated video signal encoder, for determining a predicted current frame based on a current frame and a previous frame of a digital video signal, comprising:
means for dividing the previous frame into one or more segmented regions;
means for providing one or more displacement vectors between the current and the previous frames, each of said one or more displacement vectors representing a motion of each of said one or more segmented regions;
means for constructing an intermediate predicted frame by translating each of said one or more segmented regions by a corresponding displacement vector; and
means for producing a motion vector for each pixel included in the intermediate predicted frame

based on said one or more displacement vectors and generating a pixel value of the previous frame which corresponds to the motion vector for each pixel of the intermediate predicted frame as the pixel value thereof, to thereby determine the predicted current frame.

2. The apparatus in accordance with claim 1, wherein said producing and generating means includes means for assigning the displacement vectors as motion vectors for corresponding pixels in a first region of the intermediate predicted frame, the first region representing pixels to each of which one pixel in the previous frame corresponds; and determining a motion vector for each pixel included in a second and third regions of the intermediate predicted frame based on motion vectors of neighboring pixels in the first region to thereby producing motion vector for each pixel included in the second and third regions of the intermediate predicted frame, the second region representing pixels to each of which no pixel in the previous frame corresponds and the third region representing pixels to each of which more than one pixel in the previous frame corresponds.

3. The apparatus in accordance with claim 2, wherein the determination of the motion vector for each pixel included in the second and third regions is carried out by averaging motion vectors of pixels in the first region which are disposed within a circle of a predetermined radius centering a pixel a motion vector of which is to be determined.

4. A method for use in a motion-compensated video signal encoder, for determining a predicted current frame based on a current frame and a previous frame of a digital video signal, comprising the steps of:

- segmenting the previous frame into one or more segmented regions;
- providing one or more displacement vectors between the current and the previous frames, each of the one or more displacement vectors representing a motion of each of the one or more segmented regions;
- constructing an intermediate predicted frame by translating each of the one or more segmented regions by a corresponding displacement vector; and
- producing a motion vector for each pixel included in the intermediate predicted frame based on said one or more displacement vectors and generating a pixel value of the previous frame which corresponds to the motion vector for each pixel of the intermediate predicted frame as the pixel value thereof, to thereby determine the predicted current frame.

5. The method in accordance with claim 4, wherein said producing and generating step includes step for

5 assigning the displacement vectors as motion vectors for corresponding pixels in a first region of the intermediate predicted frame, the first region representing pixels to each of which one pixel in the previous frame corresponds; and determining a motion vector for each pixel included in a second and third regions of the intermediate predicted frame based on motion vectors of neighboring pixels in the first region to thereby producing motion vector for each pixel included in the second and third regions of the intermediate predicted frame, the second region representing pixels to each of which no pixel in the previous frame corresponds and the third region representing pixels to each of which more than one pixel in the previous frame corresponds.

10 6. The method in accordance with claim 5, wherein the determination of the motion vector for each pixel included in the second and third regions is carried out by averaging motion vectors of pixels in the first region which are disposed within a circle of a predetermined radius centering a pixel a motion vector of which is to be determined.

15 20 7. An apparatus, for use in a motion-compensated video signal decoder, for determining a predicted current frame based on a previous frame of a video signal and one or more displacement vectors transmitted from an encoder, wherein the encoder includes means for dividing the previous frame into one or more segmented regions and means for providing said one or more displacement vectors between a current frame and the previous frame, each of said one or more displacement vectors representing a motion of each of said one or more segmented regions, said apparatus comprising:

- means for dividing the previous frame into one or more segmented regions;
- means for constructing an intermediate predicted frame by translating each of said one or more segmented regions by a corresponding displacement vector; and
- means for producing a motion vector for each pixel included in the intermediate predicted frame based on said one or more displacement vectors and generating a pixel value of the previous frame which corresponds to the motion vector for each pixel of the intermediate predicted frame as the pixel value thereof, to thereby determine the predicted current frame.

25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 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3235 3240 3245 3250 3255 3260 3265 3270 3275 3280 3285 3290 3295 3300 3305 3310 3315 3320 3325 3330 3335 3340 3345 3350 3355 3360 3365 3370 3375 3380 3385 3390 3395 3400 3405 3410 3415 3420 3425 3430 3435 3440 3445 3450 3455 3460 3465 3470 3475 3480 3485 3490 3495 3500 3505 3510 3515 3520 3525 3530 3535 3540 3545 3550 3555 3560 3565 3570 3575 3580 3585 3590 3595 3600 3605 3610 3615 3620 3625 3630 3635 3640 3645 3650 3655 3660 3665 3670 3675 3680 3685 3690 3695 3700 3705 3710 3715 3720 3725 3730 3735 3740 3745 3750 3755 3760 3765 3770 3775 3780 3785 3790 3795 3800 3805 3810 3815 3820 3825 3830 3835 3840 3845 3850 3855 3860 3865 3870 3875 3880 3885 3890 3895 3900 3905 3910 3915 3920 3925 3930 3935 3940 3945 3950 3955 3960 3965 3970 3975 3980 3985 3990 3995 4000 4005 4010 4015 4020 4025 4030 4035 4040 4045 4050 4055 4060 4065 4070 4075 4080 4085 4090 4095 4100 4105 4110 4115 4120 4125 4130 4135 4140 4145 4150 4155 4160 4165 4170 4175 4180 4185 4190 4195 4200 4205 4210 4215 4220 4225 4230 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6235 6240 6245 6250 6255 6260 6265 6270 6275 6280 6285 6290 6295 6300 6305 6310 6315 6320 6325 6330 6335 6340 6345 6350 6355 6360 6365 6370 6375 6380 6385 6390 6395 6400 6405 6410 6415 6420 6425 6430 6435 6440 6445 6450 6455 6460 6465 6470 6475 6480 6485 6490 6495 6500 6505 6510 6515 6520 6525 6530 6535 6540 6545 6550 6555 6560 6565 6570 6575 6580 6585 6590 6595 6600 6605 6610 6615 6620 6625 6630 6635 6640 6645 6650 6655 6660 6665 6670 6675 6680 6685 6690 6695 6700 6705 6710 6715 6720 6725 6730 6735 6740 6745 6750 6755 6760 6765 6770 6775 6780 6785 6790 6795 6800 6805 6810 6815 6820 6825 6830 6835 6840 6845 6850 6855 6860 6865 6870 6875 6880 6885 6890 6895 6900 6905 6910 6915 6920 6925 6930 6935 6940 6945 6950 6955 6960 6965 6970 6975 6980 6985 6990 6995 7000 7005 7010 7015 7020 7025 7030 7035 7040 7045 7050 7055 7060 7065 7070 7075 7080 7085 7090 7095 7100 7105 7110 7115 7120 7125 7130 7135 7140 7145 7150 7155 7160 7165 7170 7175 7180 7185 7190 7195 7200 7205 7210 7215 7220 7225 7230 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9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 9625 9630 9635 9640 9645 9650 9655 9660 9665 9670 9675 9680 9685 9690 9695 9700 9705 9710 9715 9720 9725 9730 9735 9740 9745 9750 9755 9760 9765 9770 9775 9780 9785 9790 9795 9800 9805 9810 9815 9820 9825 9830 9835 9840 9845 9850 9855 9860 9865 9870 9875 9880 9885 9890 9895 9900 9905 9910 9915 9920 9925 9930 9935 9940 9945 9950 9955 9960 9965 9970 9975 9980 9985 9990 9995 10000 10005 10010 10015 10020 10025 10030 10035 10040 10045 10050 10055 10060 10065 10070 10075 10080 10085 10090 10095 10100 10105 10110 10115 10120 10125 10130 10135 10140 10145 10150 10155 10160 10165 10170 10175 10180 10185 10190 10195 10200 10205 10210 10215 10220 10225 10230 10235 10240 10245 10250 10255 10260 10265 10270 10275 10280 10285 10290 10295 10300 10305 10310 10315 10320 10325 10330 10335 10340 10345 10350 10355 10360 10365 10370 10375 10380 10385 10390 10395 10400 10405 10410 10415 10420 10425 10430 10435 10440 10445 10450 10455 10460

and third regions of the intermediate predicted frame based on motion vectors of neighboring pixels in the first region to thereby producing motion vector for each pixel included in the second and third regions of the intermediate predicted frame, the second region representing pixels to each of which no pixel in the previous frame corresponds and the third region representing pixels to each of which more than one pixel in the previous frame corresponds.

9. The apparatus in accordance with claim 7, wherein the determination of the motion vector for each pixel included in the second and third regions is carried out by averaging motion vectors of pixels in the first region which are disposed within a circle of a predetermined radius centering a pixel a motion vector of which is to be determined.

10. A method, for use in a motion-compensated video signal decoder, for determining a predicted current frame based on a previous frame of a video signal and one or more displacement vectors transmitted from an encoder, wherein the encoder includes means for dividing the previous frame into one or more segmented regions and means for providing said one or more displacement vectors between a current frame and the previous frame, each of said one or more displacement vectors representing a motion of each of said one or more segmented regions, said method comprises steps of:

- dividing the previous frame into one or more segmented regions;
- constructing an intermediate predicted frame by translating each of said one or more segmented regions by a corresponding displacement vector; and
- producing a motion vector for each pixel included in the intermediate predicted frame based on said one or more displacement vectors and generating a pixel value of the previous frame which corresponds to the motion vector for each pixel of the intermediate predicted frame as the pixel value thereof, to thereby determine the predicted current frame.

11. The method in accordance with claim 10, wherein said producing and generating step includes step for assigning the displacement vectors as motion vectors for corresponding pixels in a first region of the intermediate predicted frame, the first region representing pixels to each of which one pixel in the previous frame corresponds; and determining a motion vector for each pixel included in a second and third regions of the intermediate predicted frame based on motion vectors of neighboring pixels in the first region to thereby producing motion vector for each pixel included in the second and third regions of the intermediate predicted frame, the second region representing pixels to each of which no pixel in the previous frame corresponds and the third region representing pixels to each of which more than one pixel in the previous frame corresponds.

5 12. The method in accordance with claim 10, wherein the determination of the motion vector for each pixel included in the second and third regions is carried out by averaging motion vectors of pixels in the first region which are disposed within a circle of a predetermined radius centering a pixel a motion vector of which is to be determined.

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FIG. 1

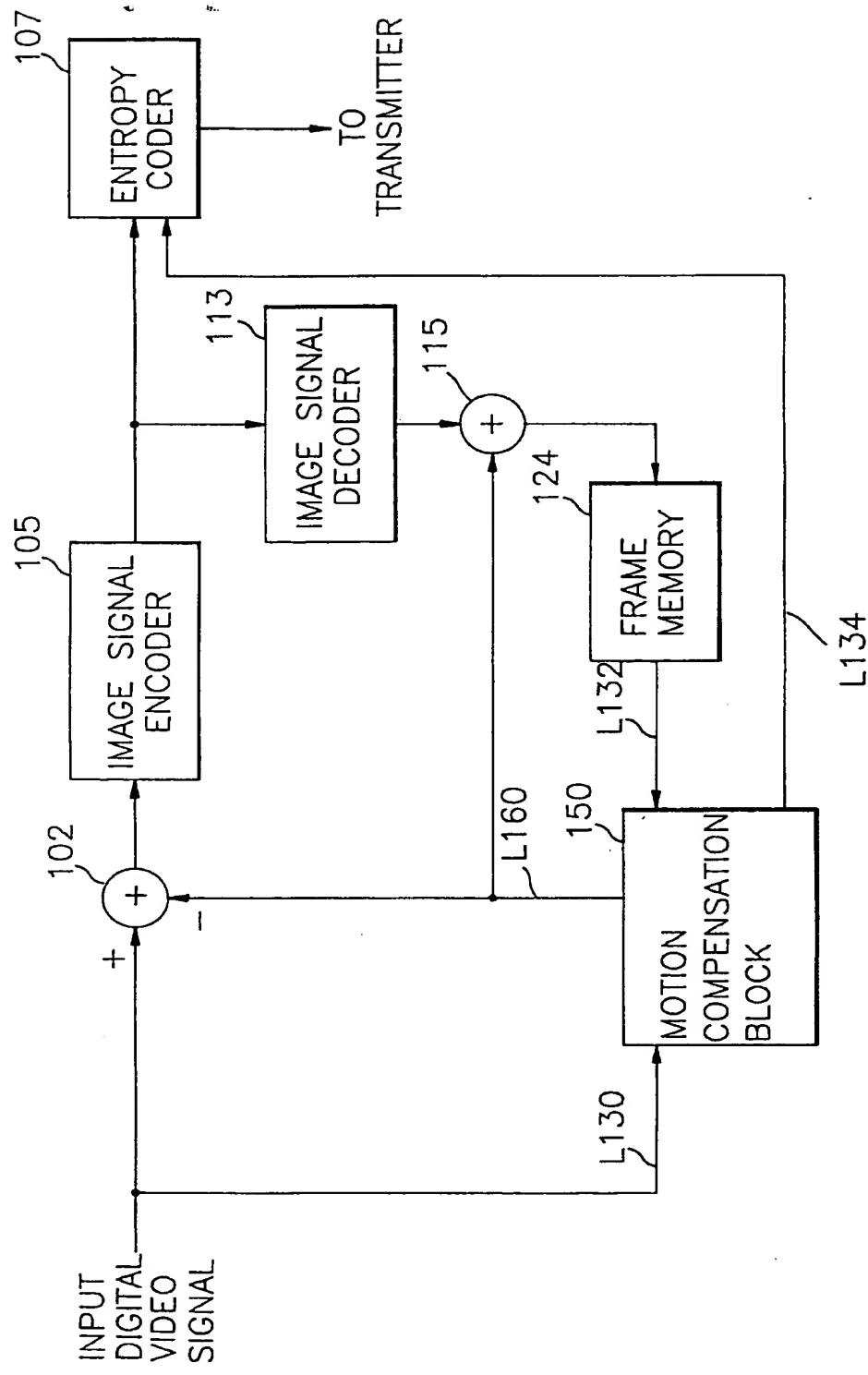


FIG.2

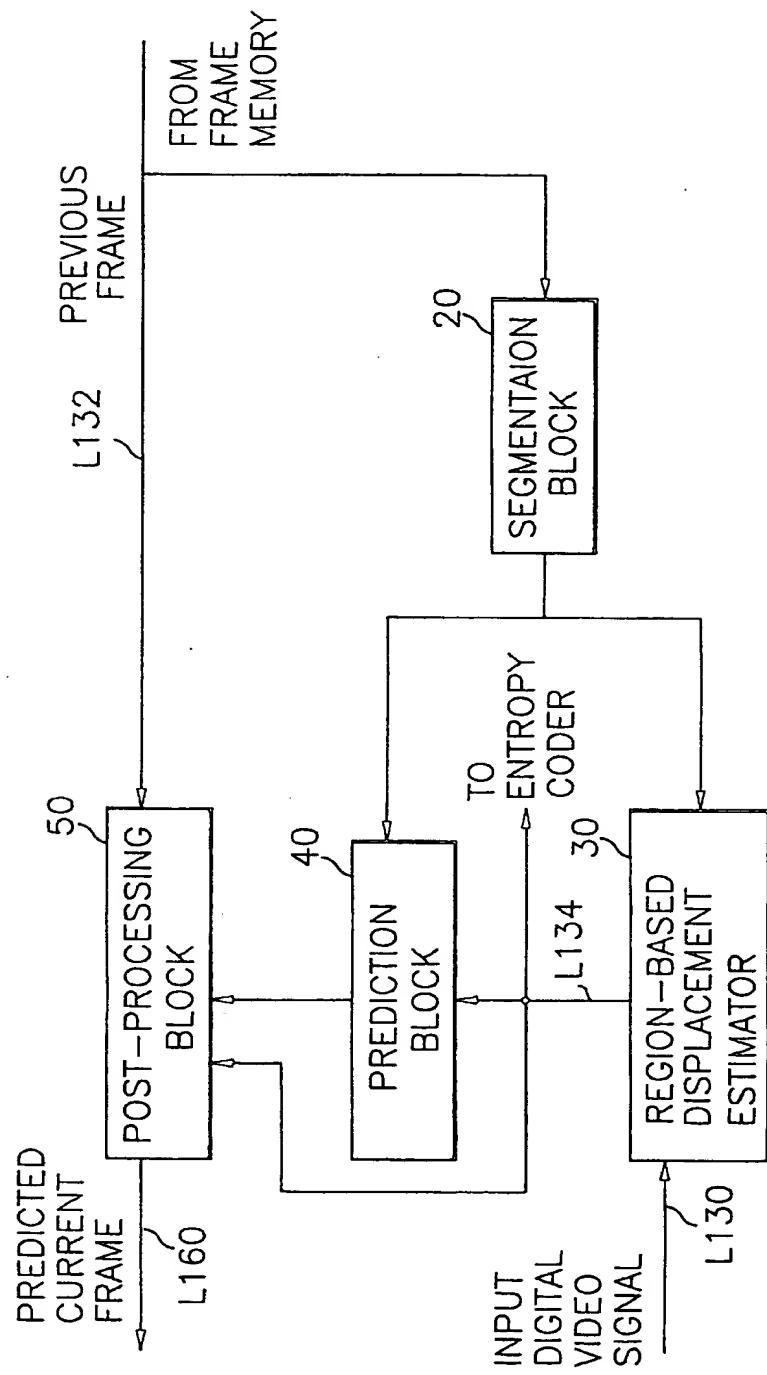


FIG. 3A

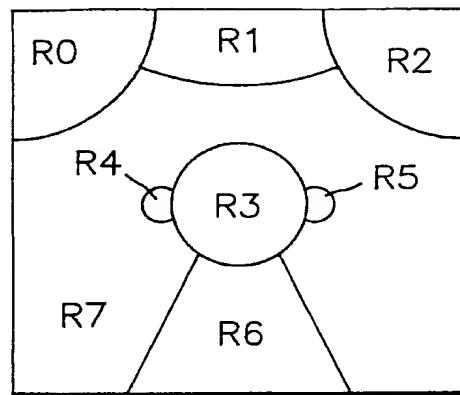


FIG. 3B

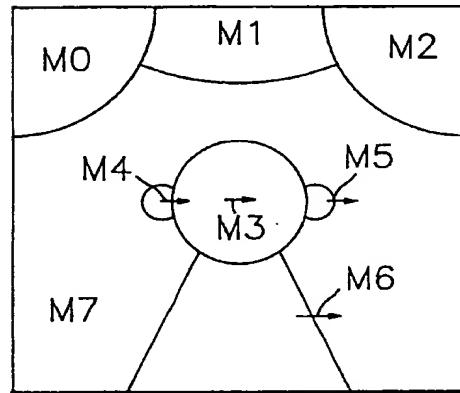
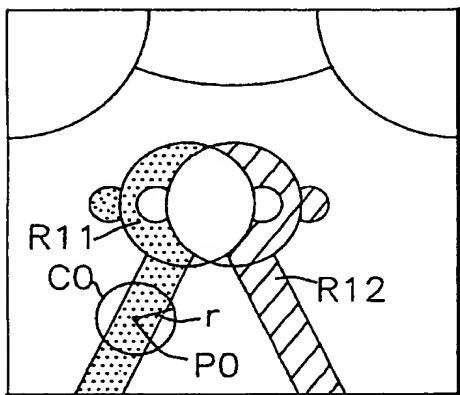


FIG. 3C





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EUROPEAN SEARCH REPORT

Application Number

EP 94 12 0966

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 625 853 (NIPPON TELEGRAPH AND TELEPHONE CORP.) * the whole document *	1-12	HO4N7/26 HO4N7/36
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THE HAGUE	7 June 1995	Foglia, P	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons A : technological background O : non-written disclosure P : intermediate document & : member of the same patent family, corresponding document	
EPO FORM 150 002 (PC01)			



European Patent
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EUROPEAN SEARCH REPORT

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)															
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A	PATENT ABSTRACTS OF JAPAN vol. 13 no. 444 (E-828) ,5 October 1989 & JP-A-01 170288 (TOSHIBA CORP.) 5 July 1989, * abstract *	1-12																
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)															
<p>The present search report has been drawn up for all claims</p> <table border="1"> <tr> <td>Place of search</td> <td>Date of completion of the search</td> <td>Examiner</td> </tr> <tr> <td>THE HAGUE</td> <td>7 June 1995</td> <td>Foglia, P</td> </tr> <tr> <td colspan="3">CATEGORY OF CITED DOCUMENTS</td> </tr> <tr> <td colspan="3"> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document </td> </tr> <tr> <td colspan="3"> T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document </td> </tr> </table>				Place of search	Date of completion of the search	Examiner	THE HAGUE	7 June 1995	Foglia, P	CATEGORY OF CITED DOCUMENTS			X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		
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